Electronic systems

Chapter 1

- Introduction
- Electronic systems
- Distortion and noise
- System design.

Introduction

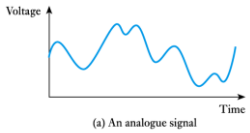
- The world in which we live is constantly changing.
- To survive, we need to respond to changes in our environment.
  - To respond we sense a changing quantity (the **input**).
  - And modify some other quantity (the **output**).
- We often use machines to respond on our behalf.
  - The nature of these machines is that they **sense** some input quantity, **process** the information, and then **control** some output quantity.

Introduction (contd.)

- The world about us is characterised by a number of **physical properties** or **quantities.**
  - e.g. temperature, pressure, humidity, etc.
- Physical quantities may be *continuous* or *discrete*.
- **Continuous quantities** change smoothly and can take an infinite number of values.
- **Discrete quantities** change abruptly from one value to another.
  - Most real-world quantities are continuous.
  - Many man-made quantities are discrete.

Introduction (contd.)

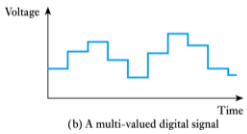
- It is often convenient to represent physical quantities by electrical signals. These can also be continuous or discrete.
- Continuous signals are often described as **analogue.**



(a) An analogue signal

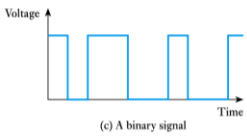
Introduction (contd.)

- Discrete signals are often described as **digital signals.**



(b) A multi-valued digital signal

- Many digital signals take only two values and are referred to as **binary signals.**



(c) A binary signal

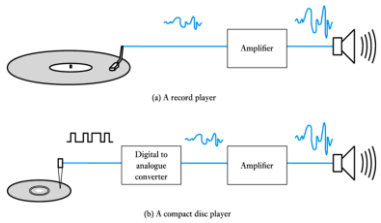
Electronic systems

- A system can be defined as

  Any closed volume for which all the inputs and output are known.
- Examples include:
  - an engine management system
  - an automotive system
  - a transportation system
  - an ecosystem.
- Inputs and outputs will reflect the nature of the system.

Electronic systems (contd.)

- Electronic systems can take many forms, for example.



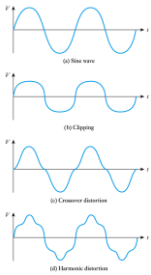
Electronic systems (contd.)

- Components that interact with the outside world are termed **sensors** and **actuators.**
  - In the previous examples the pickup or laser scanner represents a sensor.
  - In the previous examples the loudspeaker represents an actuator.

Distortion and noise

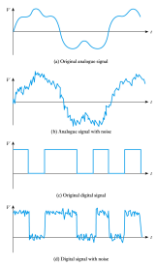
1.3

- All systems distort electrical signal to some extent
  - examples include clipping, crossover distortion and harmonic distortion.
- Distortion is **systematic** and is **repeatable.**



Distortion and noise (contd.)

- All systems also add noise to the signals that pass through them.
- Unlike distortion, noise is **random** and not repeatable.
- Noise can often be removed from digital signals but this is often impossible with analogue signals.



System design

1.4

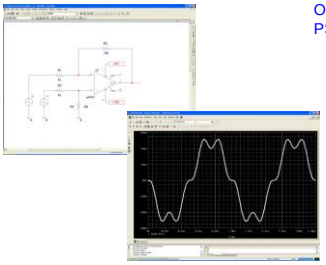
- The task of designing an electronic system can be simplified by adopting a methodical approach.
- Generally this involves a **top-down approach.**
  - Customer requirements
  - Top-level specification
  - Choice of technology
  - Top-level design
  - Detailed design
  - Module construction and testing
  - System testing.

System design (contd.)

- **Electronic design aids**
  - schematic capture
  - circuit simulation
  - PCB or VLSI layout packages.
- Circuit simulation greatly assists our understanding of the operation of a circuit.
  - Common examples include
    - ❑ PSpice
    - ❑ Multisim
    - ❑ LTspice

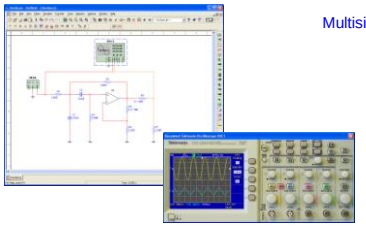
Circuit simulation

OrCAD
PSpice



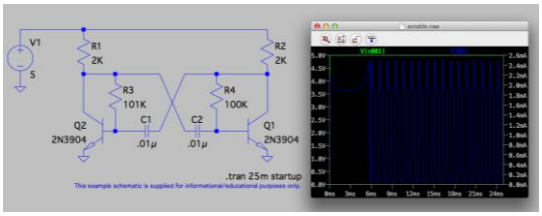
Circuit simulation

Multisim



Circuit simulation

LTSpice



Key points

- Systems interact with the world using sensors and actuators.
- Physical quantities can be either continuous or discrete.
- Physical quantities are often represented by signals.
- Useful electronic systems take input signals, process this information and produce appropriate outputs.
- Distortion and noise are always present.
- System design normally follows a top-down approach.
- Electronic design tools, such as simulators, are invaluable.